



ANCIENT EGYPTIAN HOUSES FLEXIBLE DESIGN TO ACHIEVE ITS FUNCTION WITH DIFFERENT FACTORS

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ABSTRACT

The study addressed such an important topic, which is the flexibility of design thought that was used by ancient Egyptians in designing houses and the way they excelled in considering topographic, social, economic and environmental factors. The study started by shading light on topographic and environmental factors that are represented in the general climate of northern, central and southern parts of Egypt, in addition to the effect of the Nile River. Then, the study reviewed the development of housing design throughout the different ages starting from pre-family era to the modern state then identifying the general features of the ancient housing. Accordingly, analytical study was conducted for three cities regarding site planning, horizontal projection and other different factors (economic – social - environmental). The study concluded with a group of results that show the superiority of ancient Egyptian and achieving flexibility in designing houses and setting its design features.

KEYWORDS: Climate, the annual flood of Nile, the ancient Egyptian dwelling. Ancient Egyptian civilization.

مرونه تصميم مساكن مصر القديمة بما يحقق وظيفتها مع اختلاف المحددات المتعارف عليها

ملخص البحث

عند تصميم تناولت الدراسة موضوع هاما وهو مرونة الفكر التصميمي الذي استخدمه المصري القديم المساكن وكيفية تفوقه في مراعاته للعوامل الطبوغرافية والاجتماعية والاقتصادية والبيئية، حيث بدأ البحث بالقاء الضوء على العوامل الطبوغرافية والبيئية التي تمثلت في المناخ العام لمصر والخاص لاجزاء مصر الشمالية والوسطى والجنوبية، وتأثير نهر النيل. ثم تم استعراض تطور تصميم المسكن على مر العصور المختلفة بدءا من عصر ما قبل الاسرات الى الدولة الحديثة وبعد ذلك تم تحديد الملامح العامة للمسكن القديم. ومن ثم تم تحديد ثلاث مدن بها مساكن على مر العصور المختلفة وذو مناخ مختلف وموقع مختلف وبعد ذلك تم عمل دراسة تحليلية للثلاث مدن على مستوى التخطيط للموقع وللمسقط الافقي وعلى مستوى العوامل وتم الخروج بمجموعه من النتائج التي تظهر تفوق المصري المختلف (الاقتصادية - الاجتماعية - البيئية) القديم وتحقيقه المرونه في تصميم المسكن ووضع سمات تصميمية له.

1. INTRODUCTION

Egyptians started from thousand years to dislocate towards the city but their steps were slow in the beginning, but after that, they began to accelerate their steps and constituted the ancient Egyptian civilization that grew in the Nile Valley [1].

Ancient Egyptian's architecture followed the same approach as ancient Egyptian's arts, as it has doctrinal reference undoubtedly with content bearing an objective purpose. Therefore, the architecture through all eras expresses the cultural background of arts with all its types [2]. Architecture, like other arts, is affected by surroundings of natural, geographic, historical, social, economic and other secondary factors, as no country have the same architectural models. The differences are not much attributed to the people who invented these buildings as much as to the factors that influenced their primitive manifestations translating this evolution into architectural models [3].

Ancient Egyptian civilization reacted through its early phases with several interrelated environmental and human factors. Of these factors, huge Egyptian share of Nile valley, its periodical floods, the renewable fertility of soil, semi-

2.1.1. The Nile River:

Egypt's natural scene is unique regarding its rigor and harmony; as the "southern – northern" axis consists of the Nile River that often takes straight line albeit with slight curves, as in the south Nile River extends along approximately 800 km from Aswan to Memphis constituting Upper Egypt with its continental climate Fig.1. On the opposite, Lower Egypt consisted of wide sedimentary plain with six branches of Nile constituting "Nile Delta" to the north of Memphis with the depth of 200 km with moderate climate[7].

moderate dry weather and geographic location overlooking Red and Mediterranean seas and on the angle of convergence between Africa and Asia, are the clearest and positive of these factors. There is also lack of severe terrain obstacles in the way of communicating routes and internal transportation as well as an abundance of major stones and minerals and the immunity of desert borders. Also, there is the relative density of Egyptian crowds and their tendency to social cohesion and political stability in addition to language unity and scarcity of differences in their composition [4].

2. TOPOGRAPHIC AND CLIMATIC FEATURES OF THE ENVIRONMENT IN ANCIENT EGYPT:

2.1.Topographic Aspects:

Egyptian natural manifestations are characterized by its strength, magnificence, intensity, its straight lines and the stability of its conditions over the years [5].

The Nile River is the longest known river for the ancients with the feature of annual flooding and flooding all the land of the valley leaving a deposit of slime that formed a fertile layer for abundant crops [6].



Fig.1 the Nile river[8].

The majority of researchers agreed that Nile River is the most important influential geographic phenomena in the daily life of ancient Egyptians [9].

The river flows surrounded by a network of channels [10]. All ancient Egyptian cities were established on both sides of the river. The annual flooding of the Nile River was the essential feature of the Nile [9].

2.2. Environmental Aspects:

Climate is considered as the major natural factor that affects human and his environment through the influence of its factors that change its impact on human according to geographic location. So, the natural climate had its influence on the traditional architecture that used the natural materials suitable for the environment that humans knew and practiced using it understanding its structural and thermal characteristics as well as its maintenance requirements and maintaining it[3].

Therefore, the climatic condition in Egypt had great influence on Egyptian Architectural art; as its sun gives the warmth and light through the year while the Nile and its plants inspired the Egyptian forms of the buildings, they created [11].

Egypt has been characterized, in most periods of the past and present, by a hot climate with no rains, as Egypt is differentiated land, as it is located on the borders between the temperate and tropical climate ranges[9]. In the south, starting from Aswan to Memphis approximately 800 km to the beginning of the Nile Delta, the area is located under hot climate as this area is located mainly under "the great south" that is opened to a great extent to African influences. Lower Egypt was completely different from Upper Egypt as it has mild and gentle climate and is related closely to the Mediterranean region[10].

2.3. Geological Factors

The variety of rock types characterizes Egyptian territory as it combines between fossil, sedimentary and transverse rocks formed during the four successive geological transformations. Therefore, each region of the Egyptian regions has its architectural character according to the available sources and natural resources. Perhaps the areas where granite was found to witness good resistance to the severe climate conditions that Egypt has known for eras[2]. If we try to track the major materials used as a building unit in the history of Egyptian architecture[3], we could list them in the following elements:

2.3.1. Slime

The Nile started, in the fourth geological period, to leave a residue that forms until today that is a continuous layer of slime, which is a tiny material with close granules that diverts when dried to a solid dark block. The Egyptian builders used slime or tamped land since the oldest ages and throughout the Egyptian history as a stuffing material between two opposite walls of brick, stone or to build cliffs. Slime covers the walls made of branches and parts of mats to prevent wind or rain from penetrating it and to give the light constructions hardness [6].

2.3.2. Stones

Limestone was a main building unit in the ancient state, it is considered as a soft stone. One of its types, characterized by its hardness and precision granules, was used to clad the stones used to build the pyramids and large terraces. Limestone remained used in building temples until the middle of the 18th family[5].

2.3.3. Wood

Papyrus, reeds, rush, and branches of trees that grow on the Nile banks found its place at the beginning of ancient Egyptian's architecture as it

was easy to use materials. Egyptians built their primitive huts using what suits their needs. This housing was characterized by lack of space, rotation of its outline, curved entrances and its sloping roof that could be the origin of humpback ceilings, basements, and domes in that far era[3].

2.3.4. Bricks:

Mold bricks has been the first building unit and civilization innovation in the art of architecture since thousand years as the Nile River brought to Egypt throughout history a thick layer of slime that Egyptians used, since the late pre-family era, to make bricks by mixing it with sand, chaff or other materials to strengthen its consistency and prevent it from shrinking, crack or ruining its shape when dried. Water kneaded it until it becomes viscous then it stuffed in small rectangular molds to be left in the sun to dry[11].

Since brick has great capabilities of thermal insulation, buildings built using this brick was compatible with the environment and helped to maintain the internal rooms of the buildings to have nice atmosphere in summer and warm in winter[9].

2.4. Social Factor

The impact of this factor was noted as followed:

- Dividing houses into residential units as found for example in the city of Khent Kawes, referred to earlier as every group had its silos and warehouses.
- The separation between social classes by "dividing wall" that separates between each class as in Kahn city and the allocation of separate neighborhoods for them through zoning of the neighborhoods of Tel Amarna city[12].

3. HOUSING IN ANCIENT EGYPT AND ITS DEVELOPMENT THROUGHOUT ERAS

Housing in ancient Egypt varied according to social classes. Therefore, we find royal palaces

attached to the main temple or separated from it with housing for the wealthy and another for the public. City housing differed from its counterparts in the village[9].

3.1. Pre-family Era (2300-2925 B.C)[13]

This era expresses the development phases of house exterior from the oval and round shape to square and rectangular shape. The house is likely to have one hall; the following are examples for this type of houses:

- Houses of "Mermadat Bani Salam" that had an oval shape as it had oval formed walls Fig.2. With space do not exceed one meter by half a meter and surrounded by a wall of height not more than half a meter[14].
- Houses of Al-Hammamia Area, "Al-Badary Civilization", that have round layout with oval huts and built using light materials[15].
- Al-Maadi civilization where three types of modest housing were found and the most modern ones had rectangular shape[4].
- The civilization of "Naqada II" had a model of houses with a rectangular shape with tilted facade widened at the top to ensure the stability of the bricks and to reduce the upper pressure on it, on the middle of this facade there is a narrow entrance with its sidebars threshold made of wood. It also had upper fanlight for lighting. The upper part of the back side of the facade had two narrow upper windows for lighting and maintain the inviolability of the house[4].

It could be said that two types of houses could be distinguished, the oldest was round or oval with posts planted in the ground, and the spaces between it were filled with branches and clad with mud. The other type of houses, newer one, were rectangular and built by the planted poles as the

oldest type, while its door was opened in the center of the facade overlooking one of the longitudinal sides. They added to this type of houses a wall in front of the entrance to protect the people inside the house from wind and the trespassers [1].

3.2. Old Kingdom Era (2658-2150 B.C)[13]

Independence era was characterized by the great progress in building architecture and engineering sciences[16]. This period is considered of the evolution phases of internal house division and the resulting diversity of housing models. In Hierakonpolis, the ruins of some houses of the early old state were revealed. Each of these houses consisted of two consecutive halls or yard followed by a hall. Some houses also consisted of the main hall followed by two other halls. Grain storing silos were attached to the houses, from its models it looks that some of it was completely cylindrical shape, while some of it had slightly curved sides[5].

As for the neighborhood's houses, which was necessary to be close to their tombs, none of them was found. We have been compensated for the loss of these cities by what we found from the planning of their houses on the paintings found in their graves as the ancient Egyptian engraved it to be a wall with balconies, and it is very likely that the cities were built inside a wall of bricks with balconies [17].

From the oldest ages, only some ruins remained at the ground level for houses dating back to the third and fourth families in Giza and Saqqara. They were rectangular houses towards the north in most cases consisting of four or five rooms, and the kitchen was separated from the yard [18].

3.3. The First Transition Era (2150-2100 B.C.) [13]

Small models of pottery for houses known as soul houses dating back to the first intermediate period are still maintained. Some of which

represent a courtyard and in the back has two or more rows. The yard could have rectangular basin topped by a canopy based on four supports. The house also consisted of one or more halls that receive the cold north breeze. Some houses consisted of a yard overlooking three halls with domed ceilings or consisted of a yard between two halls while some other houses consisted of two levels[5].

3.4. Middle State Era (2100-1750 B.C)[13]

The middle state is one of the best periods of ancient Egyptian's history; because it combined the glory and centrality of the ancient state with the independence and uniqueness achieved by the intellect during the first transition period[19].

Called prosperity era[16], this period expresses the variety of houses regarding space and complexity of internal division in the frame of rectangular shape according to the social class of the individuals such as the houses of "Kahoun" city attached to the pyramid of King Senusert in Fayoum low, from the twelfth family; which had a rectangular layout. These houses differed regarding space and internal division and characterized by multiple yards. Houses of the workers were close, and each facade overlooked a street or a street, as well as each of it, consisted of a small yard and a hall, two or three halls[5].

3.5. Modern State Era (1550-1067 B.C)[13]

It is considered the era of external expansion[16], as this era was characterized by welfare and the kings had an excellent position between the ancient eastern countries. Individuals' Houses had also disappeared, except some of them such as the houses of Tal Al-Amarna City and Deir Al-Madina. Amarna houses were on one floor because of its wide space and indicating that they were built according to a well-designed coherent

approach; this was expressed in the model of an ideal house with a rectangular shape and triangular division whether in the large or small house. This type also included royal palaces, houses for the rich and individuals houses. One of these samples is the palaces of king "Akhnaton", the house of minister "Nakht" and the house of sculptor "Thutmose". The middle section was always centered by a huge hall characterized by the moderate climate in summer and winter[5].

The old Egyptian also looked for the location of his residence away from the slopes of the wind whirlpools as in Maghara valley and the serpent of the servant. Houses were rarely erected on the slopes as in the old-era huts in the Maghara Valley, and Egyptians built surrounding walls for protection from the winds [20].

4. ANALYSIS OF SOME MODELS OF HOUSE OF MIDDLE AND MODERN HOUSE

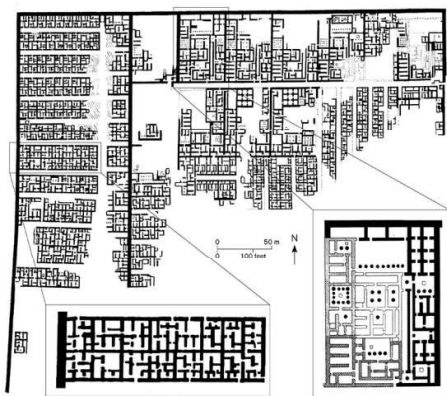


Fig. 2. Lahoun city planning[21] Fig. 3. Lahoun city[22].

The following Table 1. shows the analysis of Lahoun City and the effect of some different factors on the design characteristics of the houses. These factors are topographic factors and general design, economic, social and environmental[21].

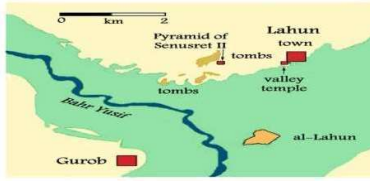

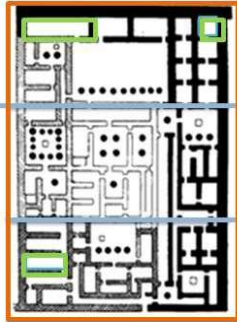
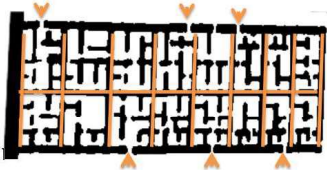
The study will view different samples of the house of ancient Egypt throughout different ages and state the influence of several different factors concerning house designs. These factors included topographic factors and general design as well as economic, social and environmental factors.

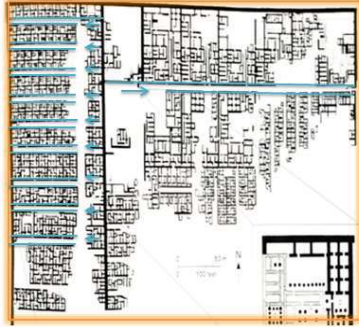


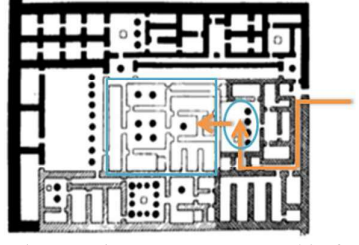

4.1. First: Analyzing The House Of "Lahoun" City, Middle Kingdom, Located In Lower Egypt:

Lahoun city was protected for being the house of the priests performing funeral services for King Senusert II. Fig. 2,3. Lahoun city had a social division of housing that divided the priests and workers according to their religious positions, as there was a separating wall built from mud-bricks that separated the northern-eastern part of the city from the northwestern and western parts of the city[21].

Table 1. the analysis of Lahoun City regarding planning and influence of different factors on the design characteristics of the house [author]:

	layout	
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<p>Location</p>	<p>Lahoun city is located close to the entrance of Fayoum city as the city was located close to the destroyed valley building called "hierarchical building" Fig.4. It is now known as Lahoun, and the pyramid is located for more than one kilometer to the west[21]</p>	 <p>Fig.4. located close to the entrance of Fayoum city[23]</p>
	<p>At the level of the city</p>	
<p>Planning</p>	<p>1. Lahoun city was centrally planned with the orthogonal design similar to royal projects in the middle state for external walls, which was almost square 384 X 335 m[21].</p> <p>2. <u>The horizontal projection shows the following:</u></p> <ul style="list-style-type: none"> • Using duplication in the planning process Fig. 5. as: • In the northeast direction from the city layout, it showed the existence of 6 models of the similar adjacent house. • In the northwest and western direction, there is a similar set of small buildings behind each other compared to buildings in the northeast. 	 <p>Fig.5. Using redundancy in the planning process.</p>
	<p>At the level of the house</p>	
	<p>The house contains two complete sets of open rooms on the central courtyard, and these rooms can be defined as residential units (and each room including a bedroom with a high bed on a platform)[21].</p> <p><u>The horizontal projection shows the following Fig.6.:</u></p> <ul style="list-style-type: none"> • Design of the house on the rectangular shape • The general shape of the horizontal projection is divided into three parts to allow air to pass through all parts of the house <ul style="list-style-type: none"> • Use of regular shapes such as a group of interconnected rooms whether they are square or rectangular. 	 <p>Fig.6. the house is divided into three parts house on the rectangular shape Using regular shapes such as a set of square and rectangular</p>
	<p>Economic factors</p>	
	<p><u>The horizontal projection of the house shows the following:</u></p> <ul style="list-style-type: none"> • Sector to the western side of the city that includes back to back rows of houses and side to side houses indicating how the workers used mutual walls between houses to reduce the cost Fig.7. • The general building is from mud-bricks. 	 <p>Fig.7. mutual walls between houses to reduce the cost</p>
	<p>Environmental factors</p>	

Effect of different factors on the house in the ancient house	<p>The city was walled by strong walls for protection, while its streets were shaped in straight lines crossed at right angles. Each street had the small stone channel in the middle of it [16].</p> <p><u>The horizontal projection of the house shows the following:</u></p> <ul style="list-style-type: none"> • The existence of narrow corridors between the residential units to have a great deal of ventilation and shadows Fig.8. • Setting houses directions to the northeast direction to provide the biggest amount of shade on facades. • Ancient Egyptian used the environmental resources available in the building place such as mud-bricks, stones, and palm trees. • Using more than one internal yard to reach thermal comfort, reducing the temperature and allowing air to pass throughout all parts of the house Fig.9. 	 <p>Fig.8. narrow corridors between the residential</p>  <p>Fig.9. More than one internal yard to reach thermal comfort.</p>
	<p style="text-align: center;">Social factors</p> <ol style="list-style-type: none"> 1. Several big houses were consisting of a big number of rooms or small houses that have limited number of rooms[21]. 2. The husband has special suite while women had their suite[21]. 3. <u>The horizontal projection of the house shows the following:</u> a small room beside the entrance of the house after entering the house from the street directly that could be the doorman or the house guard's room, followed by a set of rooms connected to a central room with the complex order (to achieve privacy) Fig.10. <ul style="list-style-type: none"> • It is likely that the real heart of this house is its core (big central courtyard) as its entrance was to the northern direction with a row of pillars from the southern side to the big yard. This entrance is far from the street entrance towards the direction of the complex to achieve privacy. Fig.11. • More than a set of rooms gathered according to use. Fig.12. 	 <p>Fig.10. Indirect entrance to privacy.</p>  <p>Fig.11. The Centra courtyard is far from the entrance to privacy</p>  <p>Fig.12. set of rooms gathered according to use</p>

4.2. Analysis Of "Amarna" City –Modern State-located In Upper Egypt:

The modern state presented us other examples of settlements such as "Workers City" Al-Amarna. This city was isolated from the main cultural center in Amarna city, mostly on the road leading to the royal tomb. It is suggested that this settlement was built as a residence for the workers in the tombs of the city who were transported from Thebes to Amarna to promote their skills in creating royal tomb's work to the new capital Fig.13,14. Unfortunately, all the above is just a guess; as the city of Amarna's workers did not have any proof documenting the function of the place or the life of its inhabitants[21].

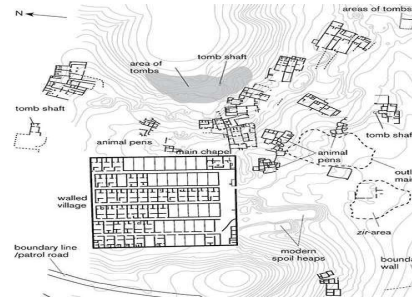

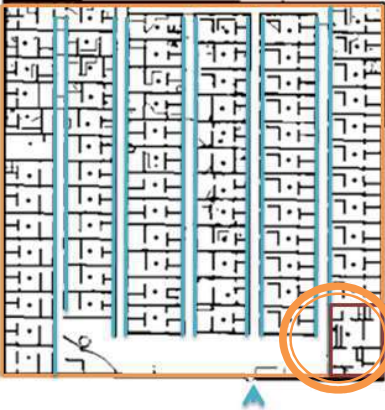


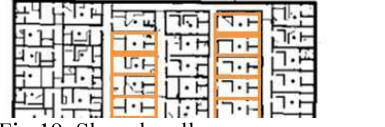


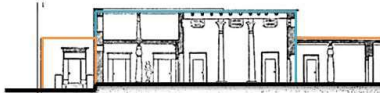
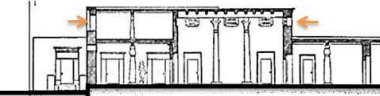


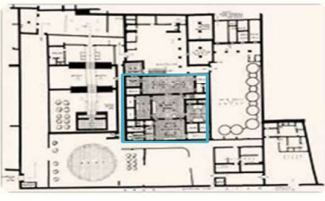

Fig.13. Workers City" al-Amarna[12]. Fig.14. City's Layout[21]

The city represented residential settlement for workers far from the main city with has rectangular shape surrounded by a wall. It had a wall dividing the city into two sectors Fig.9.; the first for the relatively higher class and the second for the poor class with its streets are perpendicular, and the houses are similar[24]. Workers city was designed on the module [16]. Table 2 shows the analysis of Amarna City and the effect of some different factors on the design characteristics of the houses. These factors are topographic, general design, economic, social and environmental factors.

Table 2. The analysis of Amarna City regarding planning and influence of different factors on the design characteristics of the house [author]:

	Layout	
	<p>The city was located on the distance between Thebes in the south and the Egyptian capital Memphis to the north and close to Fayoum Oasis. Three villages currently occupy the ruins of this city, which are Tal al-Amarna, Haj Kandil and town of Deir Mowas in Minia governorate and Al-Houta, Dairout in Asiout Fig.15. So it becomes within the fifteenth district in the heart of the valley which is Ashmounin region[25].</p>	 <p>Fig.15. Located Talal-Amarna[26].</p>
	<p>At the level of the city</p>	

<p style="text-align: center;">Planning</p>	<p>Planning of the city was based on two main roads parallel to the river. The village is surrounded by an impenetrable wall with guards on its gates, and to the south, there was the house of the general supervisor of the city [25]. Fig.16.</p> <p>1. <u>The horizontal projection of the house shows the following:</u></p> <ul style="list-style-type: none"> • This village is considered as a central planning project, which is clear in its division and strict design as shown in the general location. • Houses are lined in precise system penetrated by five streets from the north to south as the land was divided into rectangular pieces. 	 <p style="text-align: center;">Fig.16. Planning of city and the special house of the general supervisor of the city.</p>
<p>At the level of the house</p>		 <p style="text-align: center;">Fig.17. the house is divided into three parts house on the rectangular shape Using regular shapes such as a set of square and rectangular</p>
<p>Economic factors</p>		 <p style="text-align: center;">Fig. 18. Use mud brick wall[25].</p>  <p style="text-align: center;">Fig.19. Shared walls</p>
<p>Environmental factors</p>		

	<ol style="list-style-type: none"> 1. There are small high windows closed by wooden rods with putting the entrances at the edge of facades followed by corridors or separating wall (broken entrances) Fig.20., which achieved a moderate climate inside, reduced light intensity and worked to block sands from the internal parts of the house[21]. 2. The oven was the major characteristic of the place of stability as billets made of stone prevented north wind from putting out the fire of this stove[27]. 3. <u>The horizontal projection of the house showed the following:</u> <ul style="list-style-type: none"> • Ancient Egyptian used the difference in height at the surface level allowing the air to pass through different spaces Fig.21. • Directing it towards the main streets to north and south, so sunrays angle do not affect them during sunset and sunrise. • Using narrow corridors to provide a high percentage of shadows and allowing the air to pass through it quickly Fig.22. 	 <p>Fig.20. high small windows[27]</p>  <p>Fig.21. used the difference in height</p>  <p>Fig.22. use narrow corridors</p>
	<p>Social factors</p>	
<p>Effect of different factors on the house in the ancient house</p>	<ol style="list-style-type: none"> 1. Houses do not include sector for women, giving a reason to believe that the man was confined to one wife to share him his hall pointing to the rise of the status of the wife in Amarna[21]. 2. <u>The horizontal projection of the house shows the following:</u> <ul style="list-style-type: none"> • The existence of a ladder leading to the top floor that consisted of rooms used for sleeping for privacy Fig.23. • There is no more, but a set of rooms gathered according to use, which is similar to Lahoun City Fig.24. • According to this. Workers city in Amarna had a varied independent house and integrated unified settlements – available for important officers in the modern state, and it was fascinating that the specified formation of the houses and the village may differ in the available spaces, but they are very similar • The central room of the house has the most space for family's living Fig.25. 	 <p>Fig.23. use ladder leading to the top floor</p>  <p>Fig.24. Is no more than a set of rooms.</p>  <p>Fig.25. central room of the house</p>

4.3. Deir al-Madina City:

The village was built for the workers who built the royal tombs through Modern State Era (1550 to

1070 B.C.). It was home for royal tombs workers, and it could be considered as a miniature picture of life in ancient Egypt. The

village is located in the depth of the valley and could not be seen from the majority of the main points of the region[28]. The city of Deir al-Madina is considered the major source of evidence on cities and villages of ancient Egypt Fig. 26. It represents

the best proof concerning the urban planning of a town/village for the size and nature of individual houses and lives of people who live in this city and these houses.

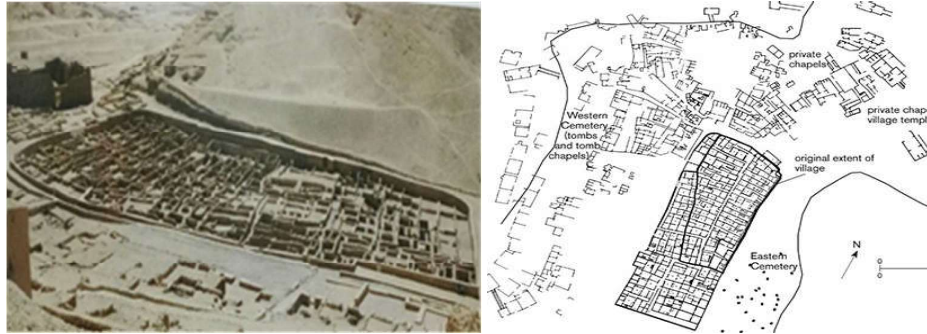



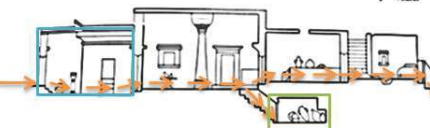
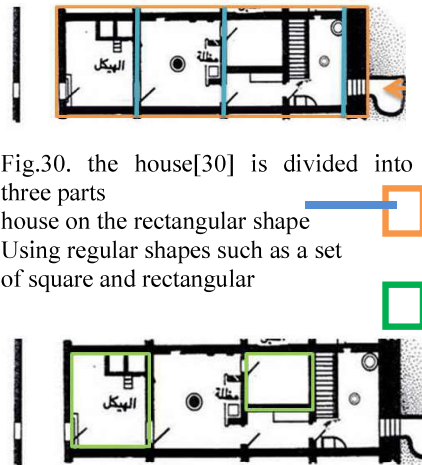
Fig. 26. City of Deir al-Madina[21].



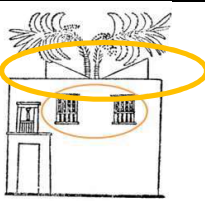
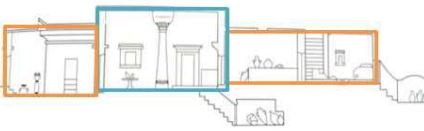

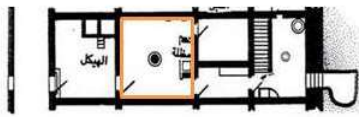
The city was built as a resident for workers in building and decorating tombs in the Valley of Kings. It was built in the era of 18th family, but grew and expanded during 19th and 20th families and extended beyond its walls. High classes inhabited the heart of the city, while the simple classes lived outside the walls of the city[24]. They were workers and artists who supervised the

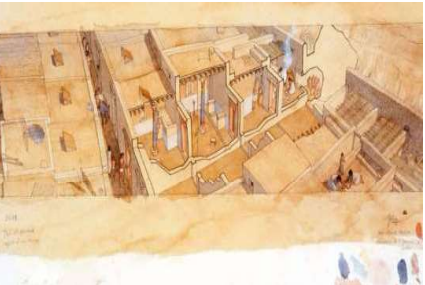
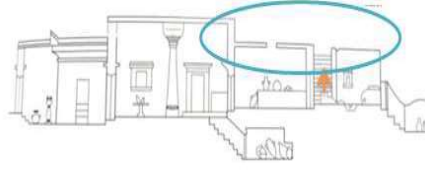
digging and engraving of tombs of the kings, queens and the sons of their house and the tombs of their graves in one region[29]. Table 3. shows the analysis of Deir al-Madina City and the effect of some different factors on the design characteristics of the houses. These factors are topographic, general design, economic, social and environmental factors.

Table 3. The Analysis of Deir al-Madina City regarding planning and influence of different factors on the design characteristics of the house [author]:

	Layout	
	<p>It is located to the west of Luxor on the west bank of the Nile and between Valley of Kings and Queens. The main road is from the north of the village from its west coast along the upper part of the cliffs surrounding the eastern monastery to the place where the workers established a small settlement for themselves before descending to the Valley of Kings. The village of Deir al-Madina is a small settlement about 2 km to the west bank of the Nile[28].</p>	
	<p>at the level of the city:</p>	<p>Fig.27. The location of Deir al-Madina[29].</p>

	<p>1. The city consisted of 68 house (although more houses were built outside the main village), surrounded by a wall. The main entrance of the village was located on its northern side allowing access to the main street that passes in the middle of the village. The number of houses in the worker's village reached seventy houses within the wall surrounding the city that reached about 131 meters from north to south and 50 meters from east to west[21].</p> <p>2. <u>The horizontal projection of the general layout showed the following Fig.28:</u></p> <ul style="list-style-type: none"> • It was divided into two equal sectors separated by a street extending from north to west and houses were adjacent. • Planning of the city took semi-regular shape that was represented in its final shape. • Planning of some streets was directed towards west-east. 	 <p>Fig.28.the city surrounded by a wall divided into two equal sectors takes semi-regular shape</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Planning</p>	<p>At the level of the house</p>	
	<p>Deir al-Madina was a real village that developed throughout ages, as there were no two completely similar houses. It could cope with the real needs of families that live within it, and the level of this room was lower than the ground level of the street by two or three degrees. Women in the city were performing household duties of the daily life of ancestors. The city was full of different tools of banquet tables, walkways, utensils and the main furniture in the room was the custom sofa as it was currently to receive guests. The room had stairs leading to the underground warehouse to maintain all precious belongings of the family Fig. 29. [21].</p> <p>3. <u>The horizontal projection of the house shows the following Fig.30.:</u></p> <ul style="list-style-type: none"> • The general form of the horizontal projection in the house design took rectangular shape. • The horizontal projection of the ground floor divided the house into three parts despite the small size of the house. • It used regular forms such as square and rectangular connected rooms as in the worker's houses in Amarna. 	 <p>Fig.29. the different of the ground level household duties of the daily life of ancestors underground warehouse</p>  <p>Fig.30. the house[30] is divided into three parts house on the rectangular shape Using regular shapes such as a set of square and rectangular</p>
	<p>Economic factors:</p>	

	<p>1. Houses were built without foundations from stones to a height of 150 cm above the ground level then the building was completed by mud-bricks Fig. 31. [27].</p> <p>2. Roofs were made of mud-bricks reinforced by wooden supports. Fig.32. [27].</p> <p>3. <u>The horizontal projection of the house shows the following:</u></p> <ul style="list-style-type: none"> • Houses were adjacent, as they left no space between each house and the other. While the two adjacent houses often shared one wall. 	 <p>Fig.31. Wall was made of mud-bricks [31].</p>  <p>Fig.32. Roofs were made of mud-bricks reinforced by wooden supports[29].</p>
	<p>Environmental factors:</p>	
	<p>1. A window and walls provided room lights were painted with the white color to reflect sunrays Fig.33. [21].</p> <p>2. <u>The horizontal projection of the house shows the following:</u></p> <ul style="list-style-type: none"> • Ancient Egyptian used the difference between heights of roofs as there were rooms with higher ceiling from the other ceilings of the house allowing air to pass through different spaces Fig.34. • We notice that ancient Egyptian used wind catch to get wind that works to moisture inside the house Fig.33. • Houses were not different from its counterparts in any other place, as it overlooked narrow corridors to give the biggest amount of shadows to protect people from sunrays Fig.35. The direction of main streets was north-south to prevent sun inclination angle from affecting them at sunrise and sunset. • Planning of the house was solid design to exist spaces represented in the exposed internal courtyard or more to find an outlet that allowed cold air to penetrate all parts of the house. Fig.36. 	 <p>Fig.33. Room lights were provided by a window and. used wind catch</p>  <p>Fig.34 used the difference between heights of roofs</p>  <p>Fig.35. used narrow corridors</p>  <p>Fig.36. used internal courtyard</p>
	<p>Social factors:</p>	

Effect of different factors on the house in the ancient house	<p>1. The women room could be reached from the kitchen at the back of the house then reaching the cellar of pottery and jars. The kitchen could also be reached from the roof of the house, which is a place where people rest and talk. It is also used as a place to put various trash and included baking and cooking tools from mop Fig.37, kneading, water jars and oven tools. It was covered from one side by a window made of tree branches for protection from sunrays[21].</p> <p><u>2. The horizontal projection of the house shows the following Fig.38. :</u></p> <ul style="list-style-type: none"> • Communication and bonding between the women room and the kitchen. • The use of flat surfaces in relaxation and recreation 	 <p>Fig.37. exterior for house[32].</p>  <p>Fig. 38. The use of flat surfaces in relaxation and recreation Use stair to roof</p>
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5. CONCLUSIONS AND RECOMMENDATIONS

We conclude from the study to a set of results, which indicated that ancient Egyptians were characterized by flexibility in putting design criteria that were shown in the design of cities and houses under the different condition including (environmental – social – economic) factors; as they achieved the functional relevance including:

At the planning level

1. Ancient Egyptians were distinguished in selecting the location of the city and its relation to the adjacent place, which had the impact on neighborhoods of the new cities whether regarding selecting fertile land influenced by the Nile River or depending on its resources in reviving cities.
2. Ancient Egyptians depended on the regular module in the planning of the cities beside duplication in the planning process whether for streets or house.
3. Simplicity played a vital role in building houses that were represented in the rectangular or square shape surrounded by a wall in most cases.

4. Achieving basis and theories of internal coordination of residential spaces known as triple division and performing designs through work module.

Environmentally

5. Houses were arranged in adjacent lines overlooking narrow streets, as this achieved that model of suitable climatic treatments of the urban space as a whole. This planning allowed the air to flow through streets in a natural and healthy way to ventilate houses and the light penetration. It also helped in reducing sunlight and reaching the biggest amount of shadows.
6. Surrounding cities using the high wall for protection from unfavorable wind with dust and sand and worked on securing the house from flooding.
7. Dependence on the mass gradient of the spaces of the house to facilitate air movement and natural light of the house through intermittent air currents, which helped to moderate and cool the air inside the blanks all the time.
8. Using projections and yards to benefit from ventilation, light, and wind to reach the comfort of inhabitants.

9. Ancient Egyptians depended on the right direction of house distribution to benefit from environmental factors as they directed the movement routes in the east-west direction to avoid sun inclination angle and its reflection during sunset and sunrise.
10. Depending on small high windows as well as the difference between roof's levels to allow air and light to penetrate through it and achieving the required internal environmental efficiency.

Socially

11. It became clear that ancient Egyptians were interested in providing and having privacy and family relation in the ancient Egyptian houses, which was represented in using refracted entrance and complex arrange of rooms and gathering it in someplace.
12. Ancient Egyptians also used bedrooms in some rooms above the house to be far from people and caring about the central rooms to be living rooms. They also used roofs for rest, talking and having family relations.
13. Ancient Egyptians used the local resources of the location as they depended while building on using stones, mud-bricks and the slime resulting from Nile flooding that is all natural materials that achieve the thermal comfort in the house.
14. Houses of ancient Egyptians were built in local building methods as they used the solid building, shared walls and simple facades that gave the Egyptian houses its economic characteristics.

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مرونة تصميم مساكن مصر القديمة بما يحقق وظيفتها مع
اختلاف المحددات المتعارف عليها

ملخص البحث

تناولت الدراسة موضوع هاماً وهو مرونة الفكر التصميمي الذي استخدمه المصري القديم عند تصميم المساكن وكيفية تفوقه في مراعاته للعوامل الطبوغرافية والاجتماعية والاقتصادية والبيئية. حيث بدأ البحث بالقاء الضوء على العوامل الطبوغرافية والبيئية التي تمثلت في المناخ العام لمصر والخاص لأجزاء مصر الشمالية والوسطى والجنوبية. وتأثير نهر النيل. ثم تم استعراض تطور تصميم المسكن على مر العصور المختلفة بدءاً من عصر ما قبل الأسرات إلى الدولة الحديثة وبعد ذلك تم تحديد الملامح العامة للمسكن القديم. ومن ثم تم تحديد ثلاث مدن بها مساكن على مر العصور المختلفة وذو مناخ مختلف وموقع مختلف وبعد ذلك تم عمل دراسة تحليلية للثلاث مدن على مستوى التخطيط للموقع وللمسقط الأفقي وعلي مستوى العوامل المختلف (الاقتصادية - الاجتماعية - البيئية) وتم الخروج بمجموعه من النتائج التي تظهر تفوق المصري القديم وتحقيقه المرونة في تصميم المسكن ووضع سمات تصميمية له.